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THESIS

ANALYSIS OF DEFERRED WORK FOR SAN DIEGO BASED DDGS

by

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June 2001

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13. ABSTRACT ***(maximum 200 words)***

The Continuous Maintenance Program is designed to maintain ships at the highest level of material condition while keeping the ships at the optimum operational readiness. In this thesis the deferred maintenance records of seven DDG's were examined during the period FY 1999 to 2000 to determine if trends existed in the types of work being deferred. First, the deferred data were grouped into categories using the System Work List Item Number from data collected in the Maintenance Support Tool. Second, compilations of the grouped data (estimated total mandays and total costs) were divided into FYs 99 and 00. Third, trends were established and then compared to FY 99 and 00 to determine consistencies. The results showed that over 60% of deferred jobs and estimated total mandays occurred in the categories of hull structure (decks), auxiliary equipment (air conditioning) and outfit/furnishing (habitability). Nearly 50% of the estimated total costs, however, occurred within the hull structure and ship support services (shipyard services) categories. Trends were also established to determine the Port Engineer's accuracy in job estimates. In FY 00, estimated deferred data were compared to FY 00 actual deferred data. The results concluded that the Port Engineers overestimated total mandays by 9% and total costs by 10%. A determination of the effectiveness of the Continuous Maintenance Program could not be reached due to the classification required to make the analysis.

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ANALYSIS OF DEFERRED WORK FOR SAN DIEGO BASED DDGS

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ABSTRACT

The Continuous Maintenance Program is designed to maintain ships at the highest level of material condition while keeping the ships at the optimum operational readiness. In this thesis the deferred maintenance records of seven DDG's were examined during the period FY 1999 to 2000 to determine if trends existed in the types of work being deferred. First, the deferred data were grouped into categories using the System Work List Item Number from data collected in the Maintenance Support Tool. Second, compilations of the grouped data (estimated total mandays and total costs) were divided into FYs 99 and 00. Third, trends were established and then compared to FY 99 and 00 to determine consistencies. The results showed that over 60% of deferred jobs and estimated total mandays occurred in the categories of hull structure (decks), auxiliary equipment (air conditioning) and outfit/furnishing (habitability). Nearly 50% of the estimated total costs, however, occurred within the hull structure and ship support services (shipyard services) categories. Trends were also established to determine the Port Engineer's accuracy in job estimates. In FY 00, estimated deferred data were compared to FY 00 actual deferred data. The results concluded that the Port Engineers overestimated total mandays by 9% and total costs by 10%. A determination of the effectiveness of the Continuous Maintenance Program could not be reached due to the classification required to make the analysis.

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I. INTRODUCTION

A. BACKGROUND

The Continuous Maintenance Program was devised because ships were spending too much time in extended shipyard availabilities and not enough time being where they were supposed to be, underway. Vice Admiral Krekich, Commander, Naval Surface Force, U.S. Pacific Fleet declared, "Warfighting skills are built at sea." He believed that a comprehensive Continuous Maintenance Program, including a nine-week shipyard availability, followed by scheduled continuous maintenance periods, would result in tremendous benefits. Some of the benefits would include improved training, operational and material readiness, greater stability in ship scheduling, reduced maintenance overhead, and improved sailor quality of life. [Proceedings, (1997)]

The Ship Maintenance Program is designed to keep the ships at the highest level of material condition possible in order for them to be effective during peace time deployments, times of war, and during routine work-up training cycles. The Ship Maintenance Program has always been an effective tool for the maintenance and modernization of the surface fleet, but it is not the most efficient one. Until recently Chief of Naval Operations (CNO) and non-CNO depot level availabilities could be as short as four months or as long as twelve months. This reduced the operational readiness of the fleet, not to mention the training readiness of the crew. Coupled with the large overhead normally associated with a stay in a shipyard the Operations and Maintenance budgets began to soar. The projected result for using nine-week shipyard availabilities vice six to nine month availabilities is approximately fourteen fewer years a ship has to

spend in a shipyard over its entire lifecycle. This is accomplished through the Class Maintenance Plan; which implements the maintenance program for an entire ship class. It defines the key elements of depot level availability, and duration intervals, and special maintenance and report requirements. In the long run this equates to a 45% reduction in overhead on such items as private contractor costs and costs to berth personnel in BEQ/BOQ's. It eliminates costs to conduct a Light Off Assessment (LOA), which must be performed if a ship is in a non-operational status for more than 120 days. [CNSP Continuous Maintenance Strategy (1997)]

The goal of the Continuous Maintenance Program is not to save money, but to ensure that the fleet is in the highest state of readiness possible for any given time period. For example, when a ship concludes its nine-week shipyard availability and transfers into a continuous maintenance period, there is an understanding between the contractor, Port Engineer, and the Commanding Officer that the availability schedule allows for the ship to get underway in 96 hours regardless of the work being performed. [CNSP Continuous Maintenance Strategy (1997)] Therefore, any work not completed in either the nine-week availability or the continuous maintenance availability is classified as deferred work. The goal is 100 percent operational readiness, but if most of the deferred work is engineering then that goal is feasibly impossible. The thrust of my research was to determine what type of work is being deferred and how this affects the overall readiness of seven DDG class destroyers stationed at Naval Station 32nd Street, San Diego, CA. There are many layers of information that make up the operational readiness of a ship, and I am looking at only one facet, a facet that begins with the training cycle and leads up to a 100% operational warship leaving for deployment.

One of the major components to the Ship Maintenance Program and the Continuous Maintenance Program is the Current Ships Maintenance Project (CSMP). The CSMP is the primary source of information regarding material condition of a ship at any one time. The Ship's Material Maintenance Officer (SMMO) aboard ship maintains the CSMP. The required maintenance jobs are completed through the aid of the Port Engineer, who is the liaison between the ship, the contractor, and the Type Commander (TYCOM). The CSMP, along with Ship's force, the Port Engineer, and a limited budget form a work package for CNO/non-CNO shipyard availabilities and continuous maintenance periods. The Port Engineer is responsible for all aspects of ship maintenance management including identification of maintenance needs, all repairs, and the overseeing of the completion of work. The CSMP is the cornerstone of the Continuous Maintenance Program because without an accurate up to date maintenance data base, required work will likely not be completed.

The ultimate goal of this thesis was to determine if the Continuous Maintenance Program is working, to establish trends in deferred work based on specific data researched for seven DDG's, and to establish a baseline to be used by other ship classes that may address where increased funding might be needed, e.g. engineering or habitability. The DDG's are the newest class of ship and also the best funded. [Meeting, Senior Port Engineer (2001)] That is why I believe this is an opportunity to establish this baseline.

B. OBJECTIVES

The objective of this thesis was to research the effectiveness of the Continuous Maintenance Program. COMNAVSURFPAC (CNSP), with the aid of the Senior Port

Engineer, had compiled data for FY99 and FY00 consisting of deferred shipyard work on all classes of ships to be completed during scheduled continuous maintenance availabilities. Specifically, an examination of the deferred work was made for seven DDG class ships stationed in San Diego to determine if any trends existed to the type and growth of deferred work since the determination and tracking of work became standard. The thesis research included:

- Identification and trends of the type of deferred work for each of the DDG's in FY 99 and FY 00.
- Determination of the cost, in mandays and dollars, of the deferred work that occurred during the two-year period, requiring additional scheduled or unscheduled Continuous Maintenance.
- Determination of the growth and type of the deferred work that occurred during the two-year period.

C. RESEARCH QUESTIONS

The following questions were addressed:

1. Primary

Is the Continuous Maintenance Program working to optimize overall readiness through decreased non-operational status while in the shipyard during CNO depot level availabilities?

2. Secondary

- What is the estimated cost in mandays and dollars of the deferred work that was not completed during the continuous maintenance program?
- Are there consistent trends in the type of work that has been deferred to the continuous maintenance program based on category and cost?
- What information exists for other surface ships regarding deferred data?
- Can this analysis be conducted on any ship class in the fleet?

D. SCOPE OF THESIS

Douglas Briscoe, the Senior Port Engineer at CNSP, compiled the data examined for this thesis for FY 99 and FY 00. The data utilized was for seven DDG-51 class

destroyers stationed in San Diego, CA. From these records a complete list of all work that was deferred for each DDG was broken out and analyzed for trends in the type of work, number of mandays to complete and cost based on a standard rate multiplied by the number of mandays. Further, the data available for this ship class were researched to determine if sufficient amounts existed to conduct this thesis.

E. METHODOLOGY

The methodology to complete this thesis included the following:

- A comprehensive literature review of instructions, the Current Ships Maintenance Projects (CSMP) and deferred maintenance logged into the Maintenance Support Tool (MST) utilized by the Port Engineers.

  A review of literature was conducted on the planning and execution of surface ship maintenance availability. It included CNO instructions, Current Ship Maintenance Projects, and MST reports. Additionally, careful interpretation was used to make statistical calculations on missing data.

- An interview with the Senior Port Engineer at CNSP in San Diego.

  An interview was conducted with the Senior Port Engineer at CNSP in San Diego regarding the initiative set by CNSP to keep the ships operational and lower the amount of deferred maintenance while staying within budget. The Port Engineers are the main focus to the success of the Continuous Maintenance Program. The Port Engineers continuously screen and validate the CSMP. [CNSP Maintenance Strategy (1997)]

- Analysis of actual deferred maintenance for FY 2000 along with the Department of the Navy's Operations and Maintenance Budget projections for Ship Depot Maintenance from FY 99 through FY 06.

  Actual Deferred Maintenance for FY 00 lists the total mandays and total dollars for all seven DDG's in the study along with the total for the entire Pacific Fleet allowing for actual and budget comparisons in FY 99 and FY 00.

- An analysis of the data for trends and comparative distributions of work categories.

  Estimated figures were compared to actual figures in determining the accuracy of manday and cost estimations made by the Port Engineers' of the seven DDG's. A comparison of the deferred work in FY 99 to FY 00 by grouping the data into System Work List Item Number categories and then evaluated the data collected on deferred work to establish trends. The

estimated cost in mandays and dollars was established for each ship to determine estimated percent total cost required to be completed during Continuous Maintenance.

F. ORGANIZATION OF STUDY

Chapter II contains the literature review. A brief discussion of maintenance records and OPNAV instructions is provided, along with a brief synopsis of the Continuous Maintenance Program.

Chapter III is a review of the methods used to conduct the research and provides the organization of the analysis.

Chapter IV presents the data and the results of the analysis along with a discussion of the results. The results are presented in graphical format and in statistical distribution divided by categories and costs by mandays and dollars.

Chapter V contains the conclusions and recommendations. There is also a section on observations and suggestions for further study.

II. LITERATURE REVIEW

The Continuous Maintenance Program is still a relatively new concept. The data that were collected for this thesis was used to establish a baseline and earmark any trends. Before these data could be analyzed it was important to understand what the Continuous Maintenance Program is all about, what the strategy is, how it is planned, and how it is implemented into the Ships Maintenance and Fleet Modernization Programs. The process was studied to learn how a job that was deferred would be completed through the continuous maintenance period. Also, the references show how the data were collected and sorted to reflect the type of job, how many mandays are required to complete it and the estimated cost.

A. CNSP CONTINUOUS MAINTENANCE STRATEGY

It all began with an idea, generated by, VADM Krekich, that a shorter industrial availability would improve the readiness of both sailors and our ships. [Proceedings (1997)] CNSP took the process onboard and implemented a Continuous Maintenance Strategy for the ships in the Pacific Fleet. The strategy was that the operations of the ships would drive the maintenance requirements. This means that there should be improved support for the Fleet Commander while providing the same level of maintenance and requisite modernization, accomplished in a nine-week shipyard availability. Followed by continuous maintenance periods for the remainder of the inter-deployment (work-up) training cycle. This presented several challenges, which were implemented as follows:

The nine-week shipyard availability was to be scheduled according to OPNAVNOTE 4700 with the notional mandays required for a specific ship class going into an availability remaining the same. This included Docking Selected Restricted Availabilities (DSRA), requiring ships to dry dock. Also, all CNO requirements were to be completed, including modernization, ship alterations, and major repairs. This would not be possible if the continuous maintenance schedule were not in place. The Continuous Maintenance Strategy allows for a ship to leave the shipyard with a bulk of the most difficult maintenance complete with the remaining work to be completed pier-side while the ship was inport. According to the CNSP Continuous Maintenance Strategy this was expected to shift the deferred work to the end of the fiscal year, affording flexible control of deferred work to be addressed by the Port Engineer in conjunction with the Commanding Officer.

Since the notional repair mandays were to remain intact, every last bit of time in the shipyard and during the continuous maintenance period had to be utilized. The concept requires the Port Engineer and Ship's Material Maintenance Officer to be vigilant in screening and validating the CSMP. Following that validation the Port Engineer would coordinate and plan the work packages with the shore based Regional Maintenance Centers and the contractors in the shipyard, ensuring the work is scheduled and completed. The strategy also provides that ship's force along with the shipyard and contractor, be proactive in conducting depot level maintenance whenever the ship was available while adhering to the 96 hour ready for sea requirement.

B. OPNAVNOTE 4700

OPNAVNOTE 4700 establishes the notional intervals, durations, maintenance cycles, and repair mandays for depot level maintenance availabilities of U.S. Navy ships. The notice applies to all active and reserve ships of the United States Navy except for civilian and Military Sealift Command ships. The notice maintains all of the requirements for the accomplishments of maintenance in five areas defined as:

- Maintenance Cycle: The period of time that starts after the completion of a ship's overhaul and ends after the completion of the next overhaul.
- Interval: The period from the completion of one scheduled depot availability to the start of the next scheduled depot availability.
- Duration: The period from the start of an availability until its completion
- Repair Mandays: Type Commander maintenance mandays typically accomplished by the executing activity to satisfactorily complete the type of availability indicated.

Table 2.1 is an example of the Maintenance Cycle of a DDG-51 Class ship.

Ship Class	Type Avail	Duration	Interval	Maintenance Cycle	Mandays
DDG-51	DSRA	3.5 Mos.	68 Mos.	71.5 Mos.	17100
	SRA	2.5 Mos.	21 Mos.		6900
	CM				1100

Table 2.1. Depot Level Maintenance Cycle (DDG-51).

The definitions of the terms above are as follows:

- SRA: A short-labor intensive industrial period assigned to ships for the accomplishment of maintenance and selected modernization. [OPNAVNOTE 4700 (2000)]
- DSRA: An SRA expanded in scope to include maintenance and modernization that require dry-docking.
- CM: Continuous Maintenance, depot level maintenance conducted annually on specified vessel outside a scheduled CNO availability.

C. OPNAVINST 4700.7J

OPNAVINST 4700.7J establishes the policy and responsibility for determining, authorizing, planning, scheduling, performing, and evaluating the maintenance of U.S. Navy ships. The general policy states that ships will be maintained in a safe material condition, in order to complete assigned missions successfully. There are two types of maintenance in the Navy, preventive and corrective maintenance. Depot level preventive maintenance items are identified and completed during specific scheduled periods in a ship's life cycle. These items are detailed in the Master Job Catalog (MJC). [Department of the Navy Instruction (1992)]

Ship's force and the Port Engineer determine the material condition of the ship and document all deferred preventive and corrective maintenance requirements regardless of who will complete the work using the CSMP. The CSMP is the most important part of the continuous maintenance program, it must be accurate and up to date or work is not scheduled or completed. It is important to understand what qualifies as depot-level work: There are four used to make the determination:

- CSMP records of the deferred and completed maintenance are evaluated.
- Objective screening of each job to determine if degradation or cause of failure results in either ship's force or depot level support is required.
- Trend predictions of future failure in material condition.
- Age reliability analysis, which provides an appropriate distribution on failures and the applicability of the required maintenance action. [Department of the Navy Instruction (1992)]

Once the assessment has been made, usually by the ship's force, the data are sent to a shore facility to be documented and a work package is planned. This is where the Port Engineer is most critical to the careful screening of each job to ensure that ship's force determination of a depot-level job is in fact depot-level. Once a job that is screened

as a depot-level job and is deemed valid, it is then ranked based on an assessment of risk of non-accomplishment to personnel safety and ship mission readiness. Authorizations of repair to work items are prioritized and the risk of each job is defined as the product of the probability of failure before the next scheduled availability and the severity of the failure.

The budget to complete a CNO scheduled availability is what drives the maintenance actions to be completed and in what order. Safety items are completed first, but the other jobs are considered based on operational necessity, cost, and schedule. The continuous maintenance program allows for some of these items to be traded-off to a later period during the Inter-Deployment Training Cycle (IDTC), giving Fleet Commanders (FLTCINCS) and Type Commanders (TYCOMS) some flexibility in their decisions. Repairs are then executed in accordance with technical requirements, to assure proper completion. Priorities are placed when a ship's ability to perform a mission safely or reliably is constrained by funding, which is almost always the case. [Department of the Navy Instruction (1992)] Safety and mission critical jobs will always be completed. It's the jobs that are critical but not mission essential that are most often delayed or deferred, a fuel oil pump for a Gas Turbine Generator is a good example. The pump is part of a redundant system and although it is critical, it would not hinder the ship from completing its mission. Therefore, there may be a delay or deferment of the job until either funding or time is available to repair it.

D. OPNAVINST 4720.2G

In order to maintain control of configuration changes and alterations to U.S. Navy ships the OPNAVINST 4720.2G, the Fleet Modernization Program (FMP), was devised.

The FMP was established to maintain control in the identification, approval, design, planning, programming, budgeting, and accomplishment of configuration changes, to include ship alterations (SHIPALTS), which increase the capability and/or reliability of a ship to perform its various missions. [Department of the Navy Instruction (1995)]

The FMP consists of a multi-year schedule of equipment installations or upgrades that must be accomplished on time. The schedule for the installations and upgrades is produced through a prioritized list of configuration changes and alterations that are to be performed, coupled with budgeted funds that are programmed by the OPNAV sponsor for a specific ship class in order to complete the installation. OPNAV develops the FMP through coordination with the appropriate Hardware Systems Command (HSC), Life Cycle Engineering Manager (LCEM) or Ship Program Managers (SPM), FLTCINCs, TYCOMs, and Commander Naval Sea Systems Command (COMNAVSEA) in order to be effective and efficient in budgeting and scheduling the alterations and installations. [Department of the Navy Instruction (1995)] With the Continuous Maintenance Program, FMP has become easier to deal with since there is greater flexibility in the scheduling of installations, but there have been some difficulties as well. Such as, installations require more time than estimated, a mandatory 96-hour requirement for the ship is to get underway, or unforeseen interferences coupled with an installation. [Meeting Senior Port Engineer (2001)]

FMP allows for the most efficient means to upgrade or alter a ship's configuration in order to enhance operational readiness. The strict guidelines and principles behind the FMP allow for control in documentation and costs of the configuration change. Unauthorized or unsupported alterations lead to an increased cost in terms of a loss of

configuration control, inefficiencies due to unexpected interferences, installation of systems and/or equipment which are logistically unsupported, and an unnecessary expenditure of resources for items that are not required. All changes and alteration must be done following the FMP process. [Dept of the Navy Instruction (1995)]

E. CLASS MAINTENANCE PLAN

The Class Maintenance Plan is a detailed, comprehensive document for implementing the maintenance program for an entire ship class. This document specifies key elements to include: depot level availability intervals, durations, and special maintenance support or infrastructure requirements. [Pish, Thesis (1999)] The Port Engineers use the Class Maintenance Plan to aid in the planning and configuration of a ship's upcoming availability. They then in turn can have an input into the Current Ships Maintenance Project to ensure those jobs are accurately screened to the appropriate availability. Through the Continuous Maintenance Program, Port Engineers can now screen jobs directly into those maintenance periods and concentrate on the major jobs to be completed in the shipyard.

F. MAINTENANCE SUPPORT TOOL (MST)

The Maintenance Support Tool (MST) is a tool to update and maintain all Current Ship Maintenance Projects of the ships in the Pacific Fleet. This tool keeps a historical as well as a current record of the ships along with job specification data coupled with financial figures. The MST program is making continuous maintenance possible in the Pacific Fleet. The Senior Port Engineer at CNSP sponsors MST. The MST program provides the Port Engineers with the following:

- Portability. This function allows the Port Engineer to screen, validate, and update the ships work packages without being connected to a network.

- Financial Management. MST provides the Port Engineer with information about a job cost and the effects of expenditures on available funds. The Port Engineer can reassign jobs to different availabilities and track the bottom line. The following can also be tracked, growth work, new work, long lead time materials, award fees, planning costs where the funding is coming from. Lastly, reports on deferred work can be compiled due to funding shortfalls.
- Master Job Catalog. When a master job is completed all other jobs associated with the master job are identified as completed on the ship's CSMP.
- Class Maintenance Plan (CMP) management. This allows the Port Engineer to add CMP tasks to the ships Availability Work Packages.
- Feedback. There is nearly instantaneous feedback to the ship on the status of a job or the entire CSMP.
- Simplicity. The MST program is easy to use. [CNSP Port Engineer Maintenance Support Tool (1998)]

G. SYSTEM WORK LIST ITEM NUMBER

The basis for this study is the System Work List Item Number (SWLIN) table. The SWLIN works by assigning different jobs a number to give a general description of the area or equipment that is affected by each work item. Any maintenance performed can be categorized using the SWLIN table and from this trends can be found, clearly identifying where deferred maintenance is taking place and where a more concentrated effort would be more effective and efficient. SWLINs are separated into ten categories. Table 2.2 shows a summary and brief description of these categories. [Pish, Thesis (1999)]

This chapter provided a brief synopsis of what is involved in Ships Maintenance and continuous maintenance. Chapter three will review the organization of the analysis along with the methods used to conduct the research.

SWLIN CATEGORY	CATEGORY DESCRIPTION
0XXXX	General Guidance and Administration (QA, Sea Trials, Models, Training)
1XXXX	Miscellaneous Hull Structure (System foundations, Stacks, Sea chests, Decks)
2XXXX	Miscellaneous Propulsion Plant Systems (Main Engines, Shafting, Reduction Gear, Lube Oil Purifiers)
3XXXX	Miscellaneous Electrical Plant (Generators, Switchboards, Lighting Distribution)
4XXXX	Miscellaneous Command/Surveillance Systems (Navigation, Communications, Radar, Sonar)
5XXXX	Miscellaneous Auxiliary Systems (Air Conditioning, Heating, Fresh Water, Damage Control)
6XXXX	Miscellaneous Outfit/Furnishings (Floor Plates & Grating, Ladders, Living Spaces, Work Shops)
7XXXX	Miscellaneous Armament (Guns, Mounts, Small Arms, Munitions Storage, Ammo handling)
8XXXX	Integrated Engineering (Planning Production, Program Management)
9XXXX	Ship Assembly/Support Services (Crane Services, Dock/Undock, Utilities/Services, Contract Data)

Table 2.2. Summaries of SWLIN Categories.

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III. METHODOLOGY

A. OVERVIEW

In this chapter, I will discuss the methodology used to analyze the data used in this thesis. This will be followed by a short explanation concerning the layout and analysis techniques utilized to transform the data into useful information in support of the scope and purpose of this thesis.

B. SOURCES

In order to complete this thesis with the desired results, two sources of data were required and obtained. The first source of data was the Maintenance Support Tool (MST), which was obtained at CNSP by the Senior Port Engineer. The MST is designed to aid the Port Engineers and ship's force in recording and planning jobs to be completed at all levels of maintenance. This is especially important at the depot-level, because this tool enables the Port Engineer to accurately portray the status of any job with respect to the number of mandays required, the cost of materials, what SWLIN category the job belongs to and the total cost to complete the work. It allows the Port Engineer to maintain greater flexibility in the scheduling and budgeting of the deferred work. [Meeting, Senior Port Engineer (2001)]

The Senior Port Engineer at COMNAVSURFPAC was used as the second source of data. The Senior Port Engineer is responsible for all the ships stationed in the Pacific Fleet to include Yokosuka and Sasebo (FAR EAST), Hawaii (MIDPAC), Bremerton and Everett Washington (PACNORWEST) and the South West Regional Maintenance Center (SAN DIEGO). He has collected deferred maintenance data for FY 99 and FY 00

through the MST program in order to keep a record of maintenance as the Continuous Maintenance Program matures.

C. DATA

The deferred maintenance data were collected for seven DDG class destroyers for FY 99 and FY 00 through the MST program. The data included actual deferred maintenance, categorized into total mandays and total dollars, for surface ships with CNO scheduled and non-CNO scheduled availabilities.

The MST data for all seven ships were for each specific year FY 99 or FY 00 respectively. Each MST work sheet contained the entire CSMP from the respective ship. The CSMP was then broken down to specific job summaries. There were a total of six data fields per job. Table 3.1 shows the fields used to conduct the analysis.

FIELD	DESCRIPTION
Mandays	Total est. # of mandays to complete job
Manday Rate	Est. cost of one manday
Material	Total est. cost of material to complete job
Type Avail (TA)	Type Availabilities 1: Only TA 1, depot level jobs were analyzed
SWLIN	SWLIN number
Total Cost	Total est. cost to complete job

Table 3.1. MST Data Fields.

The Senior Port Engineer provided a copy of the Operations and Maintenance Budget for Navy Ship Depot Maintenance dated Sep 99, the actual deferred maintenance work sheets for CNO and non-CNO scheduled availabilities, and the CNSP Continuous Maintenance Strategy brief dated 1997. The analysis of the data was straightforward

since the collection of data was done consistently for FY 99 and FY 00, and all of the data recorded were deferred maintenance.

D. ANALYSIS TECHNIQUES

The data analysis required the use of the MST program and Microsoft Excel. The data for each ship were based on the Port Engineer's estimate to complete each job based on the cost of required materials, the number of mandays, and the current manday rate. The data extracted from the MST program were sorted by Work Center (WC), Job Sequence Number (JSN), date, Mandays, Material Costs, Manday Rate, Total Cost, and SWLIN number; which were transferred to the Microsoft Excel program to be analyzed. The data were sorted again by FY 99 and FY 00. Lastly, the data were sorted one more time by SWLIN number to earmark and establish trends in the specific categories. The data were then summed and grouped into a table that was graphed for easy illustration and reference.

Once all the fields were filled in, the data were converted to percentages to visually aid in the comparison between SWLIN categories and Fiscal Year (99 and 00), to determine trends in the deferred maintenance.

In some cases the SWLIN number was not put in by the Port Engineer to describe what category the job belonged. For this analysis, if no SWLIN was listed, the job was assigned a SWLIN by analyzing its description and referencing the information to the SWLIN table.

During the analysis of the data, it was noticed that several of the ships did not have data regarding deferred work in FY 99. Four of the seven DDGs had data from FY

00 only, but I believe that there is sufficient data to draw similar conclusions about the estimated deferred maintenance on these four ships.

In Chapter Four I will explain the data and show by FY and specific ship the deferred maintenance to include: the estimated cost to complete the maintenance in total mandays and total cost and compare the results to the actual deferred maintenance calculated by CNSP for FY 00.

IV. DATA

The data presented here represent FY 99 and FY 00 estimated deferred maintenance for seven DDG-51 class ships stationed in San Diego, CA. The purpose of this study was to develop a baseline, congruent to the Continuous Maintenance Program, for analyzing data and identifying trends in documented deferred maintenance. The data were readily available in the MST program.

A. DDG-53

Table 4.1 contains the estimated deferred data for DDG-53 in FY 99 and Table 4.2 shows the actual distribution by percent of total mandays and total cost.

SWLIN	Jobs deferred	Total Mandays	Total Cost ($)
1XXXX	18	2917	2,469,600
2XXXX	8	551	309,650
3XXXX	0	0	0
4XXXX	4	212	135,950
5XXXX	8	798	602,200
6XXXX	24	378	219,550
7XXXX	4	335	156,500
8XXXX	2	38	23,766
9XXXX	20	1027	802,790
Total	88	6256	4,720,006

Table 4.1. DDG-53 FY 99 Estimated Deferred Data.

SWLIN	% Jobs Deferred	Total Mandays	% Total Cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	20.45%	46.63%	52.32%
2XXXX	9.09%	8.81%	6.56%
3XXXX	0.00%	0.00%	0.00%
4XXXX	4.55%	3.39%	2.88%
5XXXX	9.09%	12.76%	12.76%
6XXXX	27.27%	6.04%	4.65%
7XXXX	4.55%	5.35%	3.32%
8XXXX	2.27%	0.61%	0.50%
9XXXX	22.73%	16.42%	17.01%
Total	**100%**	**100%**	**100%**

Table 4.2. DDG-53 FY 99 Distribution of Estimated Deferred Data.

The MST Estimated Deferred Data distribution for FY 99 shows the largest percentage of total deferred jobs occurred in SWLIN category 6XXXX followed closely by 1XXXX and 9XXXX. The lowest percentage of deferred jobs occurred in category 8XXXX. There were no deferred jobs in categories 0XXXX and 3XXXX. The largest percentage of total cost, however, occurred in SWLIN category 1XXXX, which also happens to have the largest percentage of mandays, accounting for the total cost. The smallest percentage of mandays was in category 8XXXX. The actual distribution of estimated jobs deferred, mandays and total cost for FY 99 are shown in Figure 4.1.

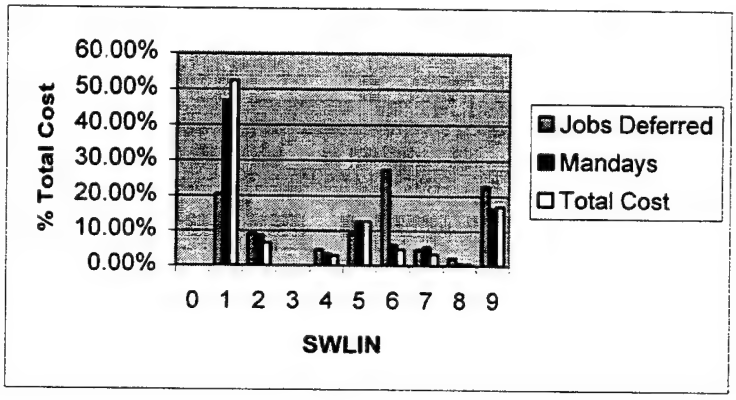

Figure 4.1. DDG 53 FY 99 Distribution of Estimated Deferred Data.

Table 4.3 contains the estimated deferred data for DDG-53 compiled for FY 00. Table 4.4 shows the actual distribution by percent of estimated total mandays and estimated total cost.

SWLIN	Jobs deferred	Total. Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	28	692	323,450
2XXXX	2	158	75,200
3XXXX	2	40	18,000
4XXXX	0	0	0
5XXXX	9	170	89,500
6XXXX	20	2906	1,356,900
7XXXX	1	175	72,500
8XXXX	0	0	0
9XXXX	0	0	0
Total	62	4141	1,935,550

Table 4.3. DDG-53 FY 00 Estimated Deferred Data.

SWLIN	% Jobs deferred	% Total Mandays	% Total Cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	45.16%	16.71%	16.71%
2XXXX	3.23%	3.82%	3.89%
3XXXX	3.23%	0.97%	0.93%
4XXXX	0.00%	0.00%	0.00%
5XXXX	14.52%	4.11%	4.62%
6XXXX	32.26%	70.18%	70.10%
7XXXX	1.61%	4.23%	3.75%
8XXXX	0.00%	0.00%	0.00%
9XXXX	0.00%	0.00%	0.00%
Total	**100.00%**	**100.00%**	**100.00%**

Table 4.4. DDG-53 FY 00 Distribution of Estimated Deferred Data.

The MST actual distribution of estimated deferred data for FY 00 shows the largest percentage of total deferred jobs occurred in SWLIN category 1XXXX, followed by 6XXXX. The lowest percentage of deferred work occurred in 7XXXX. There was no deferred work in SWLIN categories 0XXXX, 4XXXX, 8XXXX, and 9XXXX. The largest percentage of total cost occurred in category 6XXXX along with the highest percentage of mandays. The lowest percentage of total cost was in 3XXXX along with the lowest mandays. The distribution of estimated jobs deferred, mandays and total cost are shown in Figure 4.2.

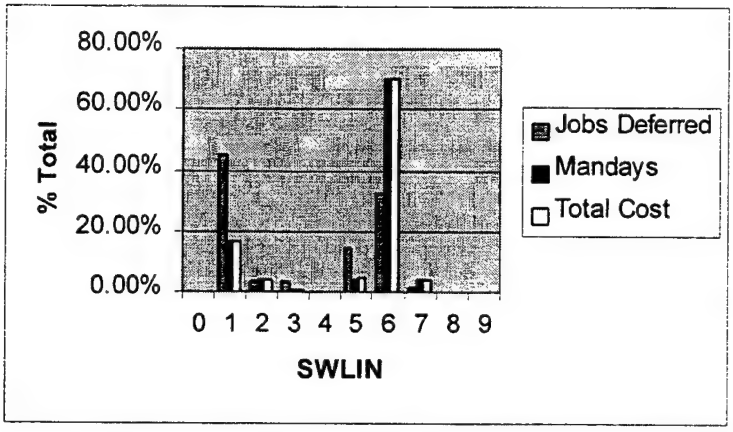

Figure 4.2. DDG-53 FY 00 Distribution of Estimated Deferred Data

Comparison of the two DDG-53 distributions shows some similarities between the two FYs. The largest percentage of estimated jobs deferred was consistent in SWLIN categories 1XXXX and 6XXXX, but Category 9XXXX was significantly different. This can be attributed to a CNO shipyard availability that DDG-53 completed in FY 99 where support services for the ship were necessary. These services are described in SWLIN category 9XXXX. In comparing the two FYs, it is important to note that the total number of estimated deferred jobs decreased from 88 jobs to 62 jobs and the estimated total cost decreased from $4,720,000 to $1,935,550. Again this can be attributed to the CNO availability.

The estimates by the Port Engineers are a critical factor for the success of the Continuous Maintenance Program. Too many overestimates could result in a budget cut the following year, where underestimates could ultimately lead to shortfalls, which in turn might lead to increased deferred jobs. Table 4.5 compares estimated total cost and estimated total mandays for DDG-53 in FY 00 to the actual deferred maintenance total cost and actual total mandays.

Estimated Total Mandays	4141
Actual Total Mandays	1637
% Difference	-60%*
Estimated Total Costs	$ 1,935,550
Actual Total Costs	$ 994,229
% Difference Total Costs	-49%*
* + Actual > Estimated = Underestimated - Actual < Estimated = Overestimated	

Table 4.5. Actual vs. Estimated Total Mandays and Total Costs.

Data for the estimate by the Port Engineer shows an overestimation in the total number of mandays by 60% and the total cost by 49%. This type of estimating could lead to a budget cut next year. Some of the problems with estimating are estimating the number of mandays required for a job. In this case SWLIN category 1XXXX required a majority of the mandays. The estimate of mandays multiplied by the manday rate of $400 per manday gives a straightforward answer, but not a very accurate one.

B. DDG-62

Table 4.6 is the estimated deferred data for DDG-62. These data were compiled for FY 00 only. Table 4.7 shows the actual distribution of estimated deferred data by percent of jobs deferred, total mandays and total cost.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	40	519	423,425
2XXXX	21	438	353,450
3XXXX	2	160	105,500
4XXXX	3	47	35,300
5XXXX	44	573	311,170
6XXXX	27	473	270,400
7XXXX	0	0	0
8XXXX	0	0	0
9XXXX	6	82	34,350
Total	143	2292	1,533,595

Table 4.6. DDG-62 FY 00 Estimated Deferred Data.

SWLIN	%Jobs Deferred	%Total Mandays	%Total Cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	27.97%	22.64%	27.61%
2XXXX	14.69%	19.11%	23.05%
3XXXX	1.40%	6.98%	6.88%
4XXXX	2.10%	2.05%	2.30%
5XXXX	30.77%	25.00%	20.29%
6XXXX	18.88%	20.64%	17.63%
7XXXX	0.00%	0.00%	0.00%
8XXXX	0.00%	0.00%	0.00%
9XXXX	4.20%	3.58%	2.24%
Total	**100.00%**	**100.00%**	**100.00%**

Table 4.7. DDG-62 FY 00 Distribution of Estimated Deferred Data.

The actual distribution of estimated deferred data for DDG-62 shows the largest percentage of jobs deferred occurred in SWLIN category 5XXXX followed closely by 1XXXX. The smallest percent of deferred jobs were in 3XXXX and 2XXXX and no jobs were deferred in categories 0XXXX, 7XXXX and 8XXXX. The largest percentage of estimated total mandays occurred in category 5XXXX followed closely by 1XXXX and 6XXXX. The largest total costs occurred in SWLIN category 1XXXX and followed by 2XXXX. This can be explained by the fact that both of these categories are predominantly material driven especially in category 2XXXX, Miscellaneous Propulsion Plant Equipment. The actual distribution of estimated jobs deferred are shown in Figure 4.3.

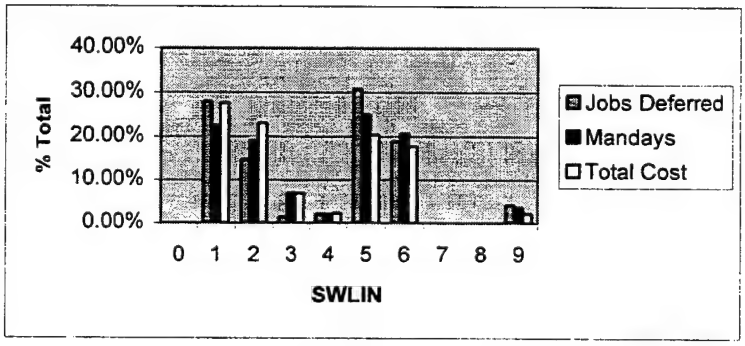

Figure 4.3. DDG-62 Distribution of Estimated Deferred Data.

Table 4.8 represents the comparison of estimated and actual deferred maintenance in total mandays and total costs for DDG-65.

Estimated Total Mandays	2292
Actual Total Mandays	2053
% Difference	**-10%***
Estimated Total Costs	$ 1,533,595
Actual Total Costs	$ 1,325,689
% Difference Total Costs	**-14%***
*** + Actual > Estimated = Underestimated - Actual < Estimated = Overestimated**	

Table 4.8. Actual vs. Estimated Total Mandays and Total Costs.

Data for the estimate by the Port Engineer for DDG-62 shows an overestimation of total mandays by 10% and total cost by 14%. This estimate could result in a budget cut, but the overestimate percentages are relatively small. The overestimates can be seen most clearly in category 1XXXX, 2XXXX, and 5XXXX. These estimates are difficult to make because in 2XXXX, Miscellaneous Propulsion Plant Systems and 5XXXX, Miscellaneous Auxiliary Systems, the mandays to complete the job can vary from the first inspection of the problem to the actual start of the job. It could take more or less mandays to complete the job.

C. DDG-63

The MST data for DDG-63 were complete for deferred work in FY 99 and FY 00. Table 4.9 is the estimated deferred data for FY 99 and Table 4.10 is the estimated distribution by percent of jobs deferred, total mandays, and total costs for FY 99. Table 4.11 is the estimated deferred data for FY 00 and Table 4.12 is the estimated distribution by percent of jobs deferred, total mandays and total costs for FY 00.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	2	39	27,484
2XXXX	2	100	76,678
3XXXX	0	0	0
4XXXX	2	30	60,500
5XXXX	2	38	108,487
6XXXX	4	142	91,762
7XXXX	0	0	0
8XXXX	0	0	0
9XXXX	0	0	0
Total	**12**	**349**	**364,911**

Table 4.9. FY 99 Estimated Deferred Data.

SWLIN	%Jobs Deferred	%Total Mandays	%Total Cost
0XXXX	**0.00%**	**0.00%**	**0.00%**
1XXXX	16.67%	11.17%	7.53%
2XXXX	16.67%	28.65%	21.01%
3XXXX	0.00%	0.00%	0.00%
4XXXX	16.67%	8.60%	16.58%
5XXXX	16.67%	10.89%	29.73%
6XXXX	33.33%	40.69%	25.15%
7XXXX	0.00%	0.00%	0.00%
8XXXX	0.00%	0.00%	0.00%
9XXXX	0.00%	0.00%	0.00%
Total	**100.00%**	**100.00%**	**100.00%**

Table 4.10. FY 99 Distribution of Estimated Deferred Data.

The MST actual distribution for estimated deferred data for FY 99 shows the largest percentage of total deferred jobs occurred in SWLIN category 6XXXX; there were five categories where the deferred jobs were zero, 0XXXX, 3XXXX, 7XXXX, 8XXXX, and 9XXXX. The SWLIN category with the largest percentage of mandays was 6XXXX and 5XXXX had the second lowest percentage, after 4XXXX. The category that had the highest total cost was 5XXXX, followed by 6XXXX. This can be explained by the high material cost associated with Auxiliary equipment. Figure 4.4 is the estimated deferred work distribution for FY 99.

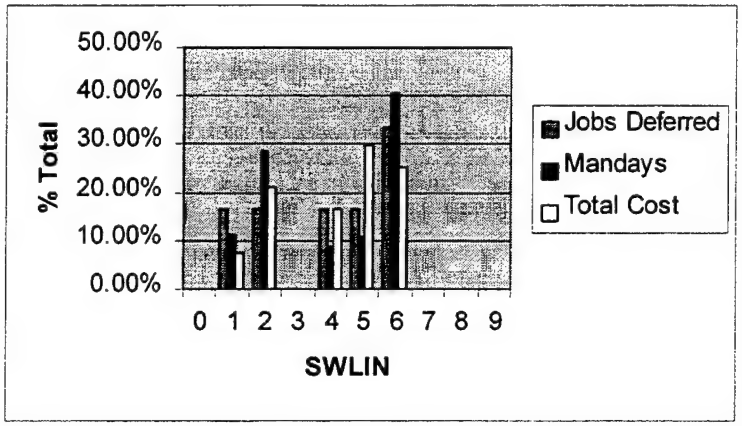

Figure 4.4. FY 99 Distribution of Estimated Deferred Data.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	8	85	47,596
2XXXX	3	43	27,477
3XXXX	8	40	22,000
4XXXX	9	45	30,250
5XXXX	8	141	137,732
6XXXX	5	91	48,079
7XXXX	1	1	400
8XXXX	1	30	12,500
9XXXX	0	0	0
Total	**43**	**476**	**326,034**

Table 4.11. FY 00 Estimated Deferred Data.

SWLIN	% Jobs Deferred	%Total Mandays	%Total Cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	18.60%	17.86%	14.60%
2XXXX	6.98%	9.03%	8.43%
3XXXX	18.60%	8.40%	6.75%
4XXXX	20.93%	9.45%	9.28%
5XXXX	18.60%	29.62%	42.24%
6XXXX	11.63%	19.12%	14.75%
7XXXX	2.33%	0.21%	0.12%
8XXXX	2.33%	6.30%	3.83%
9XXXX	0.00%	0.00%	0.00%
Total	**100.00%**	**100.00%**	**100.00%**

Table 4.12. FY 00 Distribution of Estimated Deferred Data.

The MST actual distribution of estimated deferred data for FY 00 shows the largest percentage of deferred jobs occurred in SWLIN category 4XXXX with nine deferred jobs and followed by 5XXXX, 3XXXX, and 1XXXX each with eight deferred jobs. The least amount of deferred jobs occurred in categories 7XXXX and 8XXXX, there were no deferred jobs in categories 0XXXX and 9XXXX. The SWLIN category with the largest estimate of total mandays was 5XXXX. SWLIN category 5XXXX, Miscellaneous Auxiliary Equipment, had the highest percentage of total costs along with the highest amount of material costs. The actual distribution of estimated jobs deferred, mandays and total cost are shown in Figure 4.5.

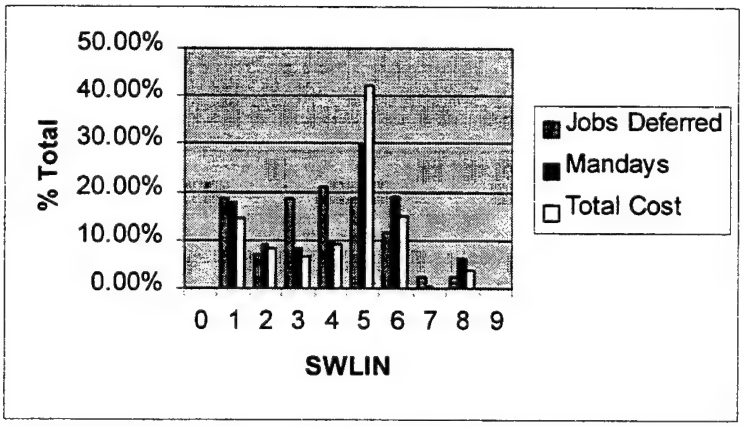

Figure 4.5. FY 00 Distribution of Estimated Deferred Data

In comparing the two distributions from FY 99 and FY 00 they are similar with respect to SWLIN category 5XXXX, Miscellaneous Auxiliary Equipment. Category 5XXXX incurred the highest total cost in both years due mainly to the material required to complete the work. In comparison, note that from FY 99 to FY 00 the number of estimated deferred jobs increased from 12 to 43 (+67%) and estimated total cost decreased from $364,911 to $326,911 (-11%).

Table 4.13 is a comparison of FY 00 estimated total mandays and costs and actual deferred maintenance total mandays and costs.

Estimated Total Mandays	476
Actual Total Mandays	770
% Difference	**+62%***
Estimated Total Costs	$ 326,034
Actual Total Costs	$ 552,358
% Difference Total Costs	**+59%***
***** **+ Actual > Estimated = Underestimated** **- Actual < Estimated = Overestimated**	

Table 4.13. Actual vs. Estimated Total Mandays and Total Costs.

The data for the estimate by the Port Engineer for DDG-63 shows an underestimation in the total number of mandays by 62% and total costs by 59%. The SWLIN category affected for DDG-63 is 5XXXX, Miscellaneous Auxiliary Systems, which difficult to estimate because of the equipment and the mandays involved. Also, the repair of Auxiliary equipment and Main Propulsion equipment usually involves high material costs, which influences the total costs. This could lead to increased deferred jobs in FY 01 due to the shortfall of mandays and total funds.

D. DDG-65

The MST data for DDG-65 were complete for FY 99 and FY 00. Table 4.14 shows the estimated deferred data for FY 99. Table 4.15 shows the actual distribution of estimated deferred data by percent of total mandays and total cost in FY 99. Table 4.16 is the estimated deferred data for FY 00. Table 4.17 shows the actual distribution of estimated deferred data by percent of total mandays and total cost for FY 00.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	24	653	296,497
2XXXX	10	340	122,726
3XXXX	6	132	64,133
4XXXX	4	30	17,476
5XXXX	9	223	265,706
6XXXX	21	391	186,873
7XXXX	0	0	0
8XXXX	6	241	100,219
9XXXX	11	538	771,568
Total	91	2548	1,825,198

Table 4.14. FY 99 Estimated Deferred Data.

SWLIN	%Jobs Deferred	%Total Mandays	%Total cost
0	0.00%	0.00%	0.00%
1	26.37%	25.63%	16.24%
2	10.99%	13.34%	6.72%
3	6.59%	5.18%	3.51%
4	4.40%	1.18%	0.96%
5	9.89%	8.75%	14.56%
6	23.08%	15.35%	10.24%
7	0.00%	0.00%	0.00%
8	6.59%	9.46%	5.49%
9	12.09%	21.11%	42.27%
Total	100.00%	100.00%	100.00%

Table 4.15. FY 99 Distribution of Estimated Deferred Data

For FY 99 the largest percentage of estimated deferred jobs occurred in SWLIN categories 1XXXX and 6XXXX. The lowest percentage of estimated deferred jobs were in category 4XXXX. There were no deferred jobs in categories 0XXXX and 7XXXX. The largest percentages of estimated total mandays were in categories 1XXXX and 9XXXX and the lowest percentage in category 4XXXX. The SWLIN category with the greatest estimated total cost, overwhelmingly, was 9XXXX. In July of 1998, DDG-65 completed an SRA. An SRA requires many 9XXXX, Ship Assembly/Support Services, type work. Eleven of these 9XXXX jobs were deferred and scheduled within the

Continuous Maintenance Program. Figure 4.6 shows the estimated distribution for FY 99.

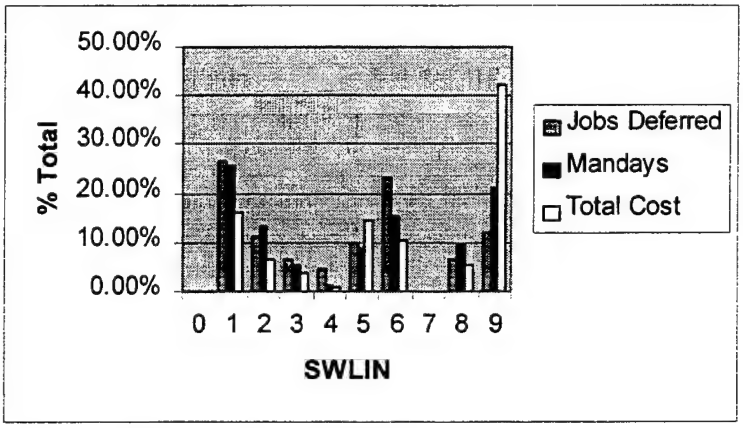

Figure 4.6. FY 99 Distribution of Estimated Deferred Data.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	14	358	171,311
2XXXX	3	316	326,681
3XXXX	2	38	24,417
4XXXX	1	13	11,800
5XXXX	7	137	66,031
6XXXX	2	20	8,669
7XXXX	2	36	16,550
8XXXX	0	0	0
9XXXX	0	0	0
Total	**31**	**918**	**625,459**

Table 4.16. FY 00 Estimated Deferred Data.

SWLIN	%Jobs Deferred	% Total Mandays	%Total Cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	45.16%	39.00%	27.39%
2XXXX	9.68%	34.42%	52.23%
3XXXX	6.45%	4.14%	3.90%
4XXXX	3.23%	1.42%	1.89%
5XXXX	22.58%	14.92%	10.56%
6XXXX	6.45%	2.18%	1.39%
7XXXX	6.45%	3.92%	2.65%
8XXXX	0.00%	0.00%	0.00%
9XXXX	0.00%	0.00%	0.00%
Total	**100.00%**	**100.00%**	**100.00%**

Table 4.17. FY 00 Actual Distribution of Estimated Deferred Data.

In FY 00, DDG-65 had the largest percentage of deferred work in SWLIN category 1XXXX. The least amount of estimated deferred work occurred in category 4XXXX, and there were no deferred jobs in categories 0XXXX, 8XXXX, and 9XXXX. The largest percentage of estimated total mandays occurred in category 1XXXX closely followed by 2XXXX. Category 2XXXX, Miscellaneous Propulsion Plant Systems incurred the largest estimated total cost due to the large estimated cost of materials to complete the work. Figure 4.7 illustrates the actual distribution of estimated jobs deferred, total mandays and total costs.

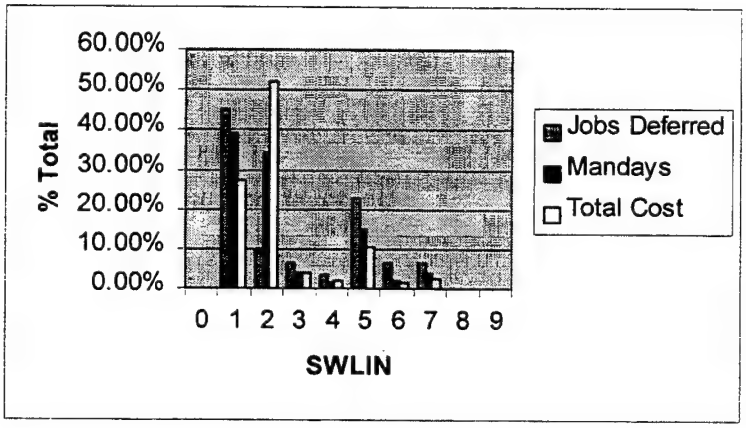

Figure 4.7. Distribution of Estimated Deferred Data

From FY 99 to FY 00 the number of estimated deferred jobs went from 91 to 31 a decrease of 64% and estimated total cost from $1,825,198 to $625,000 also a decrease of 64%. The largest percentage of estimated jobs deferred was consistent between FY 99 and FY 00 in SWLIN category 1XXXX, Miscellaneous Hull Structure. The smallest percentage of estimated jobs deferred was also consistent with SWLIN category 4XXXX, Miscellaneous Command/Surveillance Systems. One of the biggest differences between the two is the estimated cost in FY 99 in category 9XXXX due to the CNO availability completed in FY 98.

Table 4.18 is a comparison between the estimated deferred data for FY 00 and the actual deferred work for FY 00.

Estimated Total Mandays	918
Actual Total Mandays	660
% Difference	**-28%***
Estimated Total Costs	$ 625,459
Actual Total Costs	$ 491,497
% Difference Total Costs	**-21%***
* + Actual > Estimated = Underestimated - Actual < Estimated = Overestimated	

Table 4.18. Actual vs. Estimated Total Mandays and Total Costs.

The data for the estimate by the Port Engineer show an overestimation in the actual total mandays by 28% and the actual total costs by 21%. This type of estimate could result in a budget cut in the next FY. Again, the estimation becomes difficult for 1XXXX and 2XXXX jobs. A close examination of these types of jobs is required to provide an accurate estimate, which could even out the percentages.

E. DDG-69

The estimated data for deferred work on DDG-69 were compiled for FY 00 only. Table 4.19 contains the estimated deferred data for FY 00. Table 4.20 contains the actual distribution of estimated deferred data for FY 00.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	13	131	74,690
2XXXX	14	257	360,550
3XXXX	5	88	51,700
4XXXX	5	101	118,550
5XXXX	28	670	808,000
6XXXX	20	204	146,700
7XXXX	0	0	0
8XXXX	36	466	306,800
9XXXX	2	272	519,600
Total	**123**	**2189**	**2,386,590**

Table 4.19. FY 00 Estimated Deferred Data.

SWLIN	%Jobs Deferred	%Total Mandays	%Total Cost
0	0.00%	0.00%	0.00%
1	10.57%	5.98%	3.13%
2	11.38%	11.74%	15.11%
3	4.07%	4.02%	2.17%
4	4.07%	4.61%	4.97%
5	22.76%	30.61%	33.86%
6	16.26%	9.32%	6.15%
7	0.00%	0.00%	0.00%
8	29.27%	21.29%	12.86%
9	1.63%	12.43%	21.77%
Total	100.00%	100.00%	100.00%

Table 4.20. FY 00 Distribution of Estimated Deferred Data.

For DDG-69, SWLIN category 8XXXX, Integrated Engineering, had the largest percentage of estimated jobs deferred followed by category 5XXXX. The smallest percentage of deferred jobs were in category 9XXXX with two jobs, but 9XXXX accounted for 12.43% of the estimated mandays and was second with 21.77% of the estimated total cost. The largest percentage of estimated mandays occurred in category 5XXXX, and the smallest percentage in category 3XXXX. The estimated total cost was the largest in category 5XXXX, with large portions coming from total mandays and nearly $500,000 coming from estimated materials to complete the jobs. 8XXXX is usually found on new construction ships. DDG-69 had completed PSA in 1997, and completed her first SRA in 1999; some of these 8XXXX jobs were carried over from the SRA in 1999. Figure 4.8 depicts the estimated distribution for FY 00.

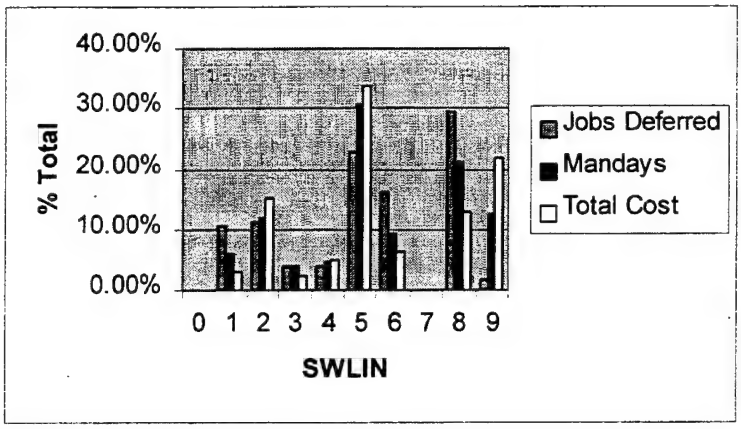

Figure 4.8. FY 00 Distribution of Estimated Deferred Data.

Table 4.21 compares the estimate of FY 00 deferred data to FY 00 actual deferred maintenance data.

Estimated Total Mandays	2189
Actual Total Mandays	2232
% Difference	**+2%***
Estimated Total Costs	$ 2,386,590
Actual Total Costs	$ 2,166,784
% Difference Total Costs	**-9%***
***** **+ Actual > Estimated = Underestimated** **- Actual < Estimated = Overestimated**	

Table 4.21. Actual vs. Estimated Total Mandays and Total Cost.

This is the most accurate estimate in the database. The data for the estimate by the Port Engineer shows an underestimation in the total number of mandays by 2% and an overestimation in the total cost by 9%. The jobs most deferred were in SWLIN category 5XXXX, these jobs can be difficult to estimate, but the Port Engineer did a good job for DDG-69.

F. DDG-73

The estimated deferred data for DDG-73 are for FY 00 only. Table 4.22 contains the estimated deferred data for FY 00 and Table 4.23 contains the actual distribution of estimated deferred data for FY 00.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	40	396	239,934
2XXXX	28	499	412,550
3XXXX	10	112	67,200
4XXXX	6	51	33,250
5XXXX	48	668	424,150
6XXXX	35	476	345,520
7XXXX	3	38	18,000
8XXXX	4	60	37,500
9XXXX	11	1408	1,128,100
Total	**185**	**3708**	**2,706,204**

Table 4.22. FY 00 Estimated Deferred Data.

SWLIN	%Jobs Deferred	%Total Mandays	%Total cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	21.62%	10.68%	8.87%
2XXXX	15.14%	13.46%	15.24%
3XXXX	5.41%	3.02%	2.48%
4XXXX	3.24%	1.38%	1.23%
5XXXX	25.95%	18.02%	15.67%
6XXXX	18.92%	12.84%	12.77%
7XXXX	1.62%	1.02%	0.67%
8XXXX	2.16%	1.62%	1.39%
9XXXX	5.95%	37.97%	41.69%
Total	**100.00%**	**100.00%**	**100.00%**

Table 4.23. FY 00 Distribution of Estimated Deferred Data.

The FY 00 data show that the largest percentage of estimated deferred jobs occurred in SWLIN category 5XXXX, followed closely by categories 1XXXX and 9XXXX which had a total of eleven deferred jobs out of 185 (5.95%). The smallest estimate of deferred jobs occurred in category 7XXXX. The largest percentage of estimated mandays occurred in category 9XXXX along with the largest percentage of estimated total cost. DDG-73 completed her first PSA in 1999 and 11 deferred jobs were

carried over to be completed during a continuous maintenance period. Figure 4.9 contains the estimated deferred data distribution for FY 00.

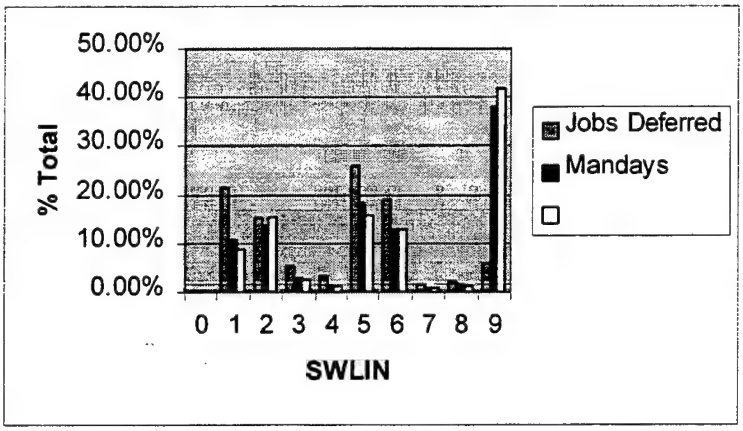

Figure 4.9. FY 00 Distribution of Estimated Deferred Data.

Table 4.24 contains the comparison of estimated deferred data to the actual deferred data for FY 00.

Estimated Total Mandays	3708
Actual Total Mandays	2810
% Difference	**-24%***
Estimated Total Costs	$ 2,706,204
Actual Total Costs	$ 2,007,453
% Difference Total Costs	**-26%***
***** **+ Actual > Estimated = Underestimated** **- Actual < Estimated = Overestimated**	

Table 4.24. Actual vs. Estimated Total Mandays and Total Costs.

The data estimate by the Port Engineer shows an overestimation of the total mandays by 24% and an overestimation of the total cost by 25%. DDG-73 had just completed PSA in 1999, and the eleven deferred 9XXXX jobs represented 1408 estimated mandays. Category 9XXXX is difficult to estimate and this could be the reason why the overestimation is so inaccurate.

G. DDG-76

DDG-76 is one of the newest DDG's in the fleet. There were no data for FY 99 so all deferred data are for FY 00. Table 4.25 contains the estimated deferred data and Table 4.26 contains the actual distribution of estimated deferred data.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	12	302	164,550
2XXXX	0	0	0
3XXXX	0	0	0
4XXXX	6	177	154,900
5XXXX	1	50	20,100
6XXXX	12	149	81,310
7XXXX	3	60	26,600
8XXXX	5	126	63,900
9XXXX	21	1078	919,125
Total	**60**	**1942**	**1,430,485**

Table 4.25. FY 00 Estimated Deferred Data.

SWLIN	%Jobs Deferred	%Total Mandays	%Total Cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	20.00%	15.55%	11.50%
2XXXX	0.00%	0.00%	0.00%
3XXXX	0.00%	0.00%	0.00%
4XXXX	10.00%	9.11%	10.83%
5XXXX	1.67%	2.57%	1.41%
6XXXX	20.00%	7.67%	5.68%
7XXXX	5.00%	3.09%	1.86%
8XXXX	8.33%	6.49%	4.47%
9XXXX	35.00%	55.51%	64.25%
Total	**100.00%**	**100.00%**	**100.00%**

Table 4.26. FY 00 Distribution of Estimated Deferred Data.

DDG-76 completed PSA in FY 00 which explains the large percentage of estimated jobs deferred in SWLIN category 9XXXX. The lowest percentage of deferred jobs occurred in category 5XXXX, Miscellaneous Propulsion Plant Systems, which makes sense for a new ship. SWLIN categories 0XXXX, 2XXXX, and 3XXXX had no

deferred jobs. 9XXXX had the largest percentage in estimated mandays and estimated total cost. 5XXXX had the lowest percentages in estimated mandays and total costs. Figure 4.10 shows the distribution for FY 00.

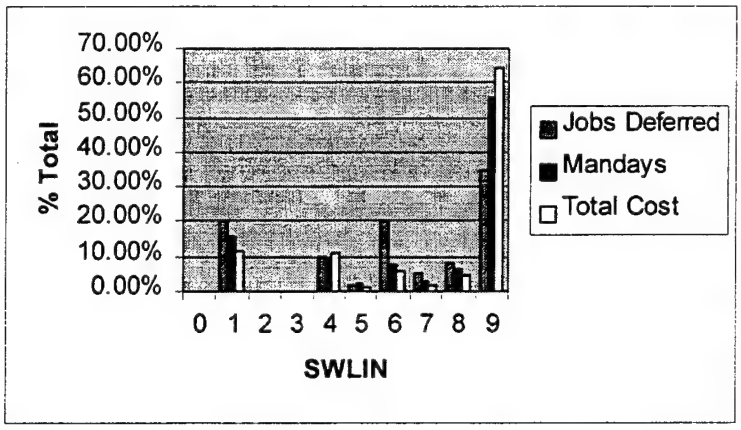

Figure 4.10. FY 00 Distribution of Estimated Deferred Data.

Table 4.27 is the comparison of the estimated deferred data to the actual deferred data for FY 00.

Estimated Total Mandays	1942
Actual Total Mandays	193
% Difference	**-90%***
Estimated Total Costs	$ 1,430,485
Actual Total Costs	$ 95,398
% Difference Total Costs	**-93%***
*** + Actual > Estimated = Underestimated - Actual < Estimated = Overestimated**	

Table 4.27. Actual vs. Estimated Total Mandays and Total Costs.

The information from this table is inconclusive and falls outside the range of any usefulness.

H. DATA ANALYSIS

The data were analyzed by SWLIN category for FY 99 and FY 00 for the estimated total deferred jobs, estimated total mandays, and estimated total cost. Next, the data were analyzed by comparing the estimated total mandays versus actual total

mandays and estimated total cost versus actual total cost in FY 00. Lastly, data were analyzed to determine if budgets for Navy Ship Depot Maintenance are funded to 85%.

1. Analysis of Deferred Data by SWLIN Category

The data for FY 99 included DDG-53, DDG-63, and DDG-65. Table 4.28, Table 4.29 and Figure 4.11 show the estimated total deferred data in FY 99, the actual distribution of estimated deferred data, and the graphs for the actual distribution.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	44	3609	2,793,581
2XXXX	20	991	509,054
3XXXX	6	132	64,133
4XXXX	10	272	213,926
5XXXX	19	1059	976,393
6XXXX	49	911	498,185
7XXXX	4	335	156,500
8XXXX	8	279	123,385
9XXXX	31	1565	1,574,358
Total	191	9153	6,909,515

Table 4.28. FY 99 Total Estimated Deferred Data.

SWLIN	%Jobs Deferred	%Total Mandays	%Total Cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	23.04%	39.43%	40.43%
2XXXX	10.47%	10.83%	7.37%
3XXXX	3.14%	1.44%	0.93%
4XXXX	5.24%	2.97%	3.10%
5XXXX	9.95%	11.57%	14.13%
6XXXX	25.65%	9.95%	7.21%
7XXXX	2.09%	3.66%	2.26%
8XXXX	4.19%	3.05%	1.79%
9XXXX	16.23%	17.10%	22.79%

Table 4.29. FY 99 Actual distribution of Total Estimated Deferred Data.

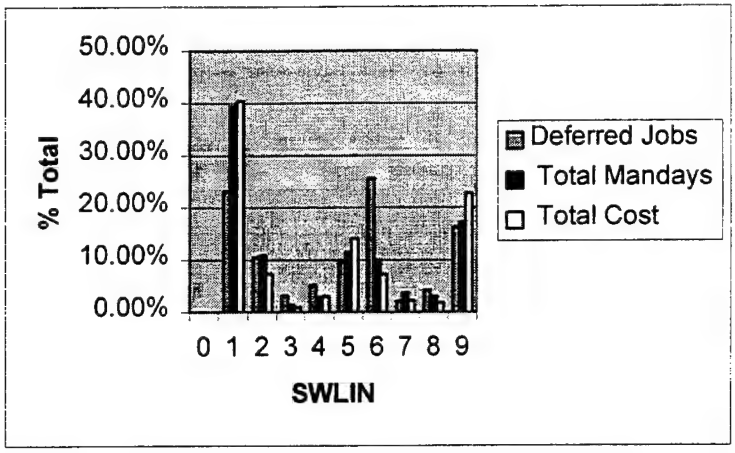

Figure 4.11. FY 99 Actual Distribution of Total Estimated Deferred Data.

The data for FY 00 included DDG-53, DDG-62, DDG-63, DDG-65, DDG-69, DDG-73, and DDG-76, since all had data available for FY 00. Table 4.30, Table 4.31, and Figure 4.12 show the total estimated deferred data by SWLIN category for all seven DDGs, the actual distribution of total estimated deferred data, and a graphical representation of the actual distribution to total estimated deferred data.

SWLIN	Jobs Deferred	Total Mandays	Total Cost ($)
0XXXX	0	0	0
1XXXX	155	2483	1,444,956
2XXXX	71	1711	1,555,908
3XXXX	29	478	288,817
4XXXX	30	434	384,050
5XXXX	145	2409	1,856,683
6XXXX	121	4319	2,257,578
7XXXX	10	310	134,050
8XXXX	46	682	420,700
9XXXX	40	2840	2,601,175
Total	**647**	**15666**	**10,943,917**

Table 4.30. FY 00 Estimated Total Deferred Data.

SWLIN	%Jobs Deferred	%Total Mandays	%Total Cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	23.96%	15.85%	13.20%
2XXXX	10.97%	10.92%	14.22%
3XXXX	4.48%	3.05%	2.64%
4XXXX	4.64%	2.77%	3.51%
5XXXX	22.41%	15.38%	16.97%
6XXXX	18.70%	27.57%	20.63%
7XXXX	1.55%	1.98%	1.22%
8XXXX	7.11%	4.35%	3.84%
9XXXX	6.18%	18.13%	23.77%

Table 4.31. FY 00 Distribution of Estimated Total Deferred Data.

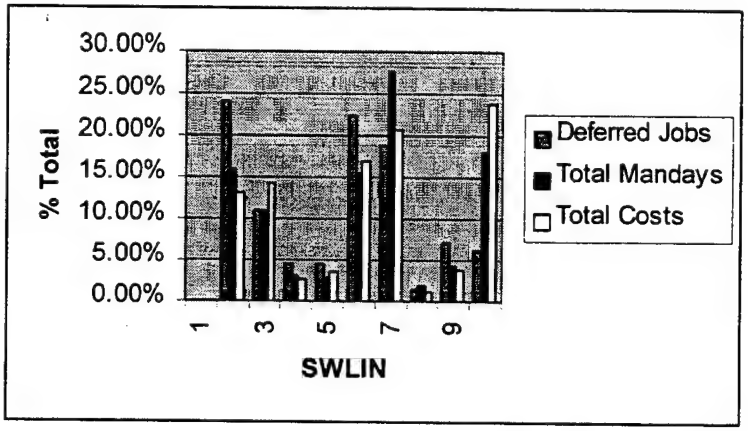

Figure 4.12. FY 00 Distribution of Estimated Total Deferred Data.

2. Analysis of FY 00 Estimated Versus Actual Deferred Data

The total estimated deferred data consisting of total mandays and total cost compiled for FY 00 were compared to the actual deferred maintenance data of total mandays and total costs to determine the effectiveness of the Port Engineer's maintenance estimates. Table 4.32 shows the comparison of estimated and actual total mandays and total costs. Table 4.33 is the distribution of the estimated and actual total mandays and costs. Figure 4.13 illustrates the distribution.

SHIP	Estimated Total Mandays	Actual Total Mandays	Estimated Total Cost	Actual Total Cost
DDG-53	4141	1637	1,935,550	994,229
DDG-62	2292	2053	1,533,595	1,325,689
DDG-63	476	770	326,034	552,358
DDG-65	918	660	625,459	491,497
DDG-69	2189	2232	2,386,590	2,116,784
DDG-73	3708	2810	2,706,204	2,007,453
DDG-76	1942	193	1,430,485	95,938
AVG	2238	1479	1,563,417	1,083,421

Table 4.32. FY 00 Actual vs. Estimated Total Mandays and Total Costs.

SHIP	%Total Mandays	%Total Cost
DDG-53	- 60%	- 49%
DDG-62	- 10%	- 14%
DDG-63	+ 62%	+ 69%
DDG-65	- 28%	- 21%
DDG-69	+ 2%	- 11%
DDG-73	- 24%	- 26%
DDG-76	N/A	N/A
AVG	- 10%	- 9%

Table 4.33. FY 00 Actual vs. Estimated Distribution.

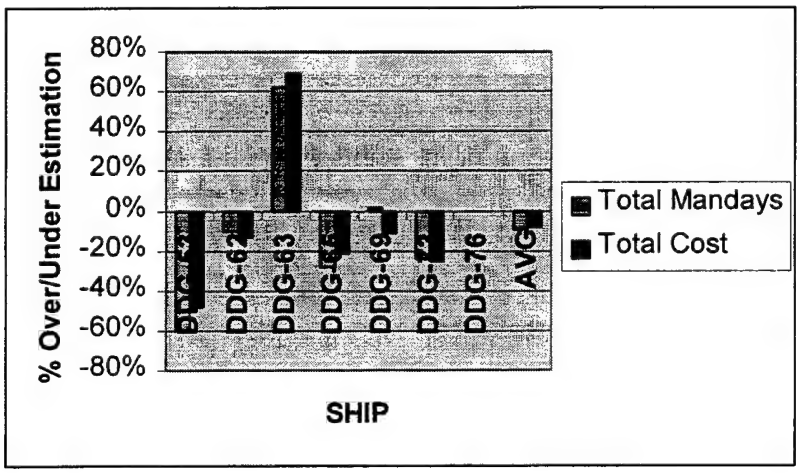

Figure 4.13. FY 00 Distribution by Ship.

The data for the estimates shows that on average the Port Engineer's overestimated the total mandays by 10% and the total costs by 9%. This overall is a

decent average. DDG-76 was eliminated from the group because its estimates were outside of useful range.

I. SUMMARY OF DATA

The Continuous Maintenance Program was devised to keep ships operational and eliminate the need to put ships entirely out of commission for extended periods of time. As a result, in 1999, CNSP initiated a requirement for all SWRMC Port Engineers to submit a weekly report on all unfunded maintenance. In the report, the Port Engineer must provide the estimated total mandays required, total cost of material required and estimated total cost. This requirement is what allowed me to complete this thesis. All of the deferred maintenance data were derived from this process. Through this process it is possible to establish a baseline from which the historical data about a ship's life cycle can specifically address deferred maintenance. The process of determining deferred maintenance and specifically using the scheduled continuous maintenance periods can decrease or even eliminate the deferred work.

J. SUMMARY OF DATA ANALYSIS

The data indicates that deferred maintenance rose from 191 jobs to 647 from FY 99 to FY 00, an increase of 239%. This may be the result of the CNSP requirement to submit weekly status reports on all ships home ported in San Diego. The Port Engineers submit a report in which all jobs that are unfunded are considered deferred. Whereas before a job that didn't have funding, may have been funded later if another job was deleted, or additional funds became available. There is also a bit of a learning curve. As the requirement for weekly reports continues on the Port Engineers will likely become better at estimating the mandays, and total costs required.

According to the data, in FY 99, SWLIN category 6XXXX, Miscellaneous Outfit/Furnishings was deferred the most at 25.65%. This category fell into the middle of the pack with respect to total mandays, and it had a relatively low total cost. The 6XXXX category is commonly deferred because of the habitability items. Habitability items are usually prioritized low. In FY 00 category 6XXXX was third with 18.70% of its jobs deferred. In FY 00 this category accounted for 27.57% of the total mandays and 20.63% of the total costs. If other work needs funding then category 6XXXX is frequently cut.

In FY 99, Category 1XXXX, Miscellaneous Hull Structure was also one of the most deferred. This is not unusual since decks fall into this category and resurfacing or resealing decks and replacing "non-skid" places this category in a low priority group. With respect to total mandays and cost, 1XXXX was the highest. In FY 00, 1XXXX was deferred the most with 23.96%, but ranked third in total mandays and fifth in total costs.

In FY 99, Category 9XXXX, Ship Assembly/Support Services, was ranked third with 16.23% of the deferred jobs. Since the Continuous Maintenance Program has been implemented, the shipyard support does not end when the ship moves to the Naval Station pier. Many support jobs have been moved from the shipyard availability to continuous maintenance availabilities scheduled throughout the year. This is an opportunity for Port Engineers to stretch the budget from the 9XXXX to other categories and hold out for 9XXXX dollars in the following FY. Category 9XXXX accounted for 23% of estimated total costs in FY 99 and 24% in FY 00. This category requires many mandays to complete work.

SWLIN category 5XXXX, Miscellaneous Auxiliary Systems was deferred 9.95% in FY 99 and 22.41% in FY 00. The 5XXXX category maintains major systems around the ship, when a job is written for auxiliary equipment, usually the cause of the problem or the severity of the problem is unknown. Therefore, 5XXXX jobs are usually overestimated, freeing up additional mandays and funds.

SWLIN category 2XXXX, Miscellaneous Propulsion Plant Systems were consistently deferred about 10% of the time both in FY 99 and FY 00. The number of deferred jobs rose in this category from 20 to 71. Category 2XXXX along with 5XXXX are usually overestimated due to not fully knowing the severity of the problems when the jobs are estimated. Also, material costs are usually high in these two categories adding to the estimate of total costs.

The categories that make up the least amount of deferred work are 4XXXX, Miscellaneous Command/Surveillance Systems, 8XXXX, Integrated Engineering, 3XXXX, Miscellaneous Electric Plant, 7XXXX, Miscellaneous Armament. These four categories were deferred between 2% and 4% of the time in FY 99, and between 1% for 7XXXX and 8% for 8XXXX in FY 00. These four categories are the lowest in terms of total mandays and in total costs. Lastly, there were no deferred jobs for SWLIN category 0XXXX, General Guidance and Administration. This category is usually reserved for new construction ships that are performing sea trials, writing up ships instructions or have not yet completed their Post Shakedown Availability (PSA).

The accuracy of the Port Engineers estimates is essential to the success of the Continuous Maintenance Program. Their estimates are what enable the ship to hold off on certain types of repairs so that others may be completed. The data comparing the

actual total mandays to estimated total mandays and actual total costs to estimated total costs were interesting. In most cases the Port Engineer overestimated the mandays and total costs. In the long run, constant overestimating can lead to budget cuts, thus possibly increasing deferred jobs. The overall results show the Port Engineers predicted the total number of mandays within 10% and total costs within 9%. The estimates, I believe, will get even better as the learning curve straightens out. The submission of the weekly reports will help this along.

Chapter V contains the conclusions and recommendations for further study regarding the research conducted in this thesis.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

Since 1999 COMNAVSURFPAC has made a concerted effort to document all deferred work in order to effectively manage the rise in deferred maintenance. The Continuous Maintenance Program was established to keep ships operationally ready and to limit the amount of time a ship spends non-operational in a shipyard. The use of the Maintenance Support Tool by the Port Engineers gives all personnel involved in maintenance an accurate picture of the status of each ship and maintains a historical record that future Port Engineers, Commanding Officers, TYCOMS, and Fleet Commanders can use to evaluate future ship's maintenance for budget and scheduling purposes.

This analysis has concluded that detailed data support is essential to the success of the Continuous Maintenance Program. The MST program provides a vital database that can be used by the Port Engineer and Ship's Force to plan and prioritize work based on ship's schedule, maintaining flexibility. The results of this thesis provide a baseline from which the information can be used to aid in budgeting for availabilities based on trends illustrating where deferred maintenance occurs most, the mandays required, and the total costs. This information could be used to significantly reduce or eliminate deferred maintenance providing that the appropriate time, personnel and funding are available.

B. RESEARCH QUESTIONS

1. Is the Continuous Maintenance Program Working to Optimize Overall Readiness by Decreasing the Amount of Time a Ship Spends Non-Operational During a CNO/Non-CNO Depot Level Availabilities?

The research into this question requires data classified SECRET to answer the question. Research would include the comparison of a ship's total operational and non-operational days at sea prior to the Continuous Maintenance Program, to the operational and non-operational days at sea after the implementation of the Continuous Maintenance Program. Data would be analyzed using the Status of Resources and Training System (SORTS) database, which is classified SECRET. According to the CNSP Continuous Maintenance Strategy the Continuous Maintenance Program would limit a ship, over its life cycle, to 14 less years spent in a shipyard and would enhance a ships operational availability from 68% to 83%. [CNSP Continuous Maintenance Strategy (1997)]

2. What is the Estimated Cost in Total Mandays and Total Dollars of the Deferred Work that was not Completed during the Continuous Maintenance Program?

The data were inconclusive for FY 99 since there were no actual data to compare to the estimates in the MST program. In FY 00, the estimated cost of deferred maintenance is shown in Table 5.1 and the actual cost of deferred maintenance is shown in Table 5.2. Table 5.3 shows how close the Port Engineers overestimated or underestimated the deferred maintenance.

FY 00	Deferred Jobs	Total Mandays	Total Cost
Total	647	15666	10943917

Table 5.1. FY 00 Estimated Total Deferred Data.

FY 00	Deferred Jobs	Total Mandays	Total Cost
Total	UNK	10356	7633408

Table 5.2. FY 00 Actual Total Deferred Data.

FY 00	Total Mandays	Total Cost
% Difference	10%	8%

Table 5.3. Port Engineers Accuracy of Estimates.

Overall, the Port Engineers overestimated the total mandays and total costs. The only data that could not be obtained was the total number of actual deferred jobs.

3. Are there Consistent Trends in the Type of Work that has been Deferred Based on SWLIN Category, Total Mandays and Total Cost?

The data analysis shows that over 60 percent of the jobs deferred were in Hull Structure, Auxiliary Equipment, and Outfit/Furnishings or habitability. The total mandays deferred were also in Hull Structure, Outfit/Furnishings and Ship Assembly/Support Services. Lastly, the deferred total costs were in SWLIN category 1XXXX, Hull Structure and 9XXXX, Ship Assembly/Support Services. SWLIN categories 1XXXX and 9XXXX are resources of mandays and dollars that are often used to complete other work of a higher priority. Table 5.4 is the total data distribution, and Figure 5.1 shows the distribution graphically.

SWLIN	%Deferred Jobs	% Total Mandays	% Total Cost
0XXXX	0.00%	0.00%	0.00%
1XXXX	23.86%	24.55%	23.74%
2XXXX	10.91%	10.89%	11.57%
3XXXX	4.20%	2.46%	1.98%
4XXXX	4.32%	2.84%	3.35%
5XXXX	19.66%	13.97%	15.87%
6XXXX	20.38%	21.07%	15.44%
7XXXX	1.68%	2.60%	1.63%
8XXXX	6.47%	3.87%	3.05%
9XXXX	8.51%	17.75%	23.39%
Total	**100.00%**	**100.00%**	**100.00%**

Table 5.4. Distribution of Total Estimated Deferred Data.

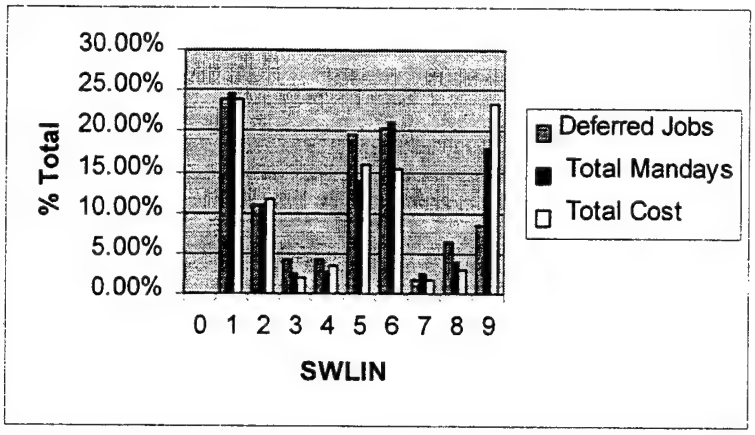

Figure 5.1. Distribution of Total Estimated Deferred Data.

4. What Information Exists for other Surface Ships Regarding Deferred Data?

The data that exists are readily available for all ship types in the Pacific Fleet. In San Diego, a weekly report is required by the Port Engineer for his/her particular ships regarding deferred jobs, total mandays and total costs, therefore all ships in San Diego have data compiled and stored in the MST database. The estimated data are subjective and are based on the Port Engineer's estimates as was shown with regard to the over or underestimation of deferred data. As the Port Engineers continue to assess deferred data using the MST program their estimates will likely become more accurate.

5. Can this Analysis be Conducted on any Class Ship in the Fleet?

This analysis was based solely on the data provided in the MST program, and the required compilations by Port Engineers. This analysis could be done on any ship in the Pacific Fleet, especially a ship stationed in San Diego. I have no data to compare the east coast ships on the type of database utilized by the Atlantic Fleet.

C. SUGGESTIONS FOR FURTHER RESEARCH

The facts presented in this thesis provided a good picture of the Continuous Maintenance Program with respect to deferred data. The following recommendations are

provided to help in determining if the Continuous Maintenance Program is effective in keeping ships operational, limiting the time spent in a non-operational status during maintenance, and if there is progress towards decreasing deferred maintenance in the fleet.

- This thesis is limited in that there were only two years of data available and those data only covered seven ships. The sole focus was on estimated deferred data compiled from Port Engineers. As the MST program matures and there is more of a history on ships, a more complete study could be done by using data from completed availabilities and comparing it with actual data.
- The data for this thesis utilized seven DDG-51 class destroyers, the newest ships in the fleet. The results for an older type ship class could be explored using the MST program to track significant changes, especially for ships nearing the end of their service life.
- OPNAVNOTE 4700 was recently changed to include Continuous Maintenance (CM) mandays for all classes of ships. The first two fiscal years of data for this thesis did not support a clear analysis of the mandays allotted. The impact on deferred maintenance could be explored as these mandays are budgeted into supporting depot maintenance.
- The data for this thesis focused on depot maintenance only. The impacts of depot level, Intermediate Maintenance level (IMA), Technical Support, and Ships Force could be explored regarding the budget process for total mandays, material costs and funding.
- The Navy has historically budgeted ship's depot maintenance to 85%. [Senior Port Engineer (2001)] The data analyzed consisted of the Department of the Navy, Ship Depot Maintenance for FY 99 through FY 06. Table 5.5 shows the percentage change in budget from the All Year Total Requirement to the Revised Individual Year Total.

Fiscal Year	Ship	All YR Total RQMT (000)	Revised IND YR Total (000)	% Change
FY 1999	**DDG-62**	4799	4554	-5.11%
FY 1999	**DDG-69**	4799	4554	-5.11%
FY 2000	**DDG-63**	5531	4814	-12.96%
FY 2000	**DDG-65**	5531	4814	-12.96%
FY 2001	**DDG-73**	5620	4891	-12.97%
FY 2001	**DDG-76**	5255	4579	-12.86%
FY 2002	**DDG-53**	5401	4710	-12.79%
			Average	**-10.68%**

Table 5.5. Average Budget Change.

The All Year Total Requirement is the amount of funding a ship would receive if it were funded to 100%. The Revised Individual Year Total is the amount of funding ships are to receive for the entire Fleet, the approximate funding is 85%. For the seven DDG class ships in this study I determined the average was about 91%. These results could be explored to determine what the fleet average on funding is and compare the results to actual expenditures in a particular Fiscal Year.

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